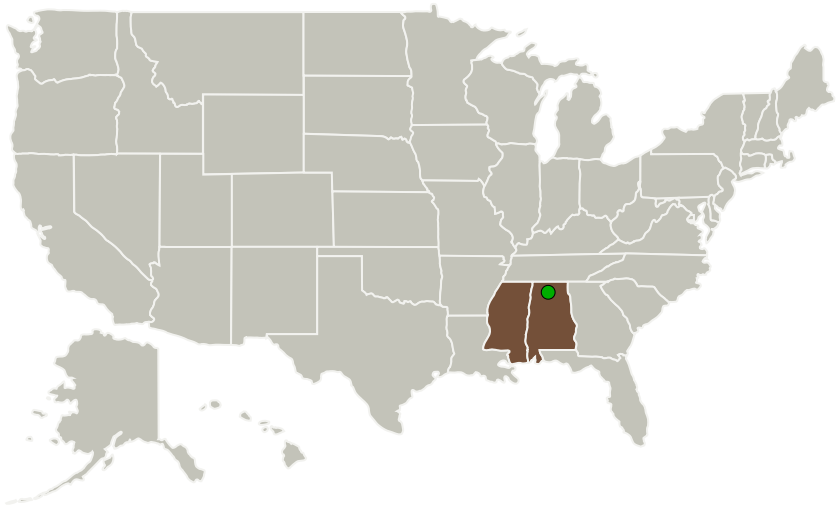
Multiphase Modeling of Solid Rocket Motor Internal Environment, Phase I

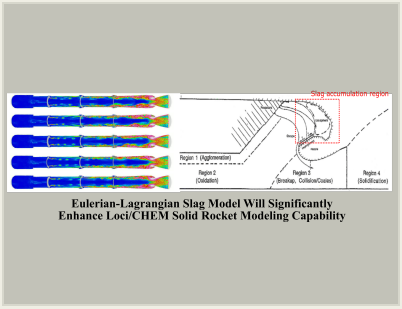
Completed Technology Project (2017 - 2018)

Project Introduction

Solid rocket motor (SRM) design requires thorough understanding of the slag accumulation process in order to: predict thrust continuity, optimize propellant conversion efficiency, predict coning effects from sloshing, and assess potential orbital debris (slag) hazard. Current state-of-the-art models for SRM environment do not have the capability to simulate the accumulation and dynamics of slag in SRMs as they rely on a Lagrangian particle approach that is only capable of predicting the location of accumulation. In this STTR effort, CFDRC will team up with Mississippi State University and Tetra Research to develop models for quantifying the effects of slag accumulation and dynamics on SRM performance. To enhance current slag modeling capabilities, an Eulerian-Lagrangian approach to accurately model a slag-phase is proposed, in which Lagrangian particles can be converted to an Eulerian description and vice-versa. The Phase I project aims at developing the basic numerical model for the transport and accumulation of a slag-phase in Loci/CHEM. The multiphase framework, comprising of gas-phase, a dense slag-phase, and Lagrangian particles representing aluminum and alumina, will be developed and demonstrated in the Phase I effort with a TRL starting at 2 and ending at 3. In Phase II, the models will be extended and validated to provide an accurate numerical approach for slag dynamics that incorporates many of the physical phenomena present during SRM operation, including the transfer from Eulerian to Lagrangian description of slag at burnout, increasing the technology readiness level by the end of a Phase II project from 3 to 5.

Primary U.S. Work Locations and Key Partners





Multiphase Modeling of Solid Rocket Motor Internal Environment, Phase I Briefing Chart Image

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Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Mississippi

Project Transitions

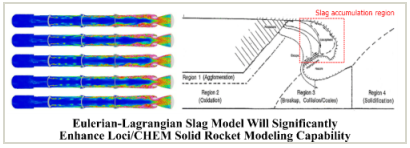
June 2017: Project Start

June 2018: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140838)*

Images



Briefing Chart Image
Multiphase Modeling of Solid Rocket Motor Internal Environment, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/129001)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
CFD Research Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

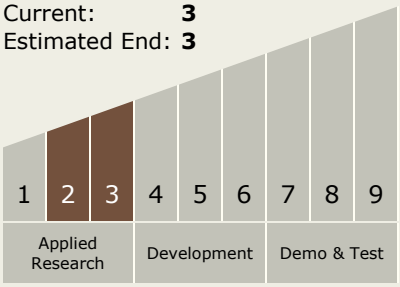
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Manuel Gale

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.4 Solids

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System